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IS 8507-1 (1977): Fixed Tantalum Capacitors with Solid Electrolyte, Part I: General Requirements and Methods of Tests [LITD 5: Semiconductor and Other Electronic Components and Devices]



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IS : 8507 (Part I) - 1977

Indian Standard

SPECIFICATION FOR FIXED TANTALUM
CAPACITORS WITH SOLID ELECTROLYTE

**PART I GENERAL REQUIREMENTS AND
METHODS OF TESTS**

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SPECIFICATION FOR FIXED TANTALUM CAPACITORS WITH SOLID ELECTROLYTE

PART I GENERAL REQUIREMENTS AND METHODS OF TESTS

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Indian Standard

SPECIFICATION FOR FIXED TANTALUM CAPACITORS WITH SOLID ELECTROLYTE

PART I GENERAL REQUIREMENTS AND METHODS OF TESTS

0. FOREWORD

0.1 This Indian Standard (Part I) was adopted by the Indian Standards Institution on 23 June 1977, after the draft finalized by the Capacitors Sectional Committee had been approved by the Electronics and Telecommunication Division Council.

0.2 This standard applies to polar and bi-polar fixed solid electrolyte tantalum capacitors of hermetically sealed, moulded and dipped types. It covers capacitors for long life applications and for general purpose applications. Capacitors for special purpose applications may need additional requirements.

0.2.1 Dimensional and specific requirements of various types of fixed tantalum capacitors will be covered in the subsequent parts of this standard.

0.3 The general requirements and tests for all types of fixed capacitors are covered in IS : 7305 (Part I)-1973*, which is a necessary adjunct to this standard.

0.4 In the preparation of this standard, assistance has been derived from the following:

40 (Sectt) 325 Fixed tantalum capacitors with liquid or solid electrolyte. Selection of methods of test and general requirements; International Electrotechnical Commission.

JSS 50205 Detail specification for capacitors, fixed, electrolyte, solid tantalum. Directorate of Standardization, Department of Defence Production, Ministry of Defence, New Delhi.

0.5 For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated,

*Specification for fixed capacitors used in electronic equipment; Part I General requirements and tests,

expressing the result of a test, shall be rounded off in accordance with IS : 2-1960*. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

1. SCOPE

1.1 This standard (Part I) covers the general requirements and methods of tests for judging the electrical, mechanical, and climatic properties of solid electrolyte tantalum capacitors intended for use in electronic and other similar equipment.

2. TERMINOLOGY

2.0 For the purpose of this standard, the terms and definitions given in IS : 7305 (Part I)-1973† and those given below shall apply.

2.1 Long Life Grade Capacitors — Capacitors intended for applications where a high degree of stability of characteristics over a long life is essential.

NOTE 1 — The materials are so chosen and manufacture so carried out, that improved performance is obtained with consequent increase in life.

NOTE 2 — The long life will correspond to 2 000 hours duration for endurance test.

2.2 General Purpose Grade Capacitor — A capacitor intended for applications where the high performance level of long life grade capacitors is not required.

NOTE — The life will correspond to 1 000 hours duration for endurance test.

2.3 Capacitance of an Electrolytic Capacitor — The capacitance of an equivalent circuit having capacitance and resistance in series, measured with alternating current of approximately sinusoidal waveform at the specified frequency.

2.4 Reverse Voltage (for Polar Capacitors Only) — A voltage applied to the capacitor terminal in the reverse polarity direction.

3. CLIMATIC CATEGORIES

3.1 The solid tantalum capacitors covered in this standard are classified into climatic categories according to the general rules given in IS : 589-1961‡.

3.2 Capacitors covered in this standard shall belong to one of the three categories given in Table 1 based on their ability to withstand the climatic severities.

*Rules for rounding off numerical values (*revised*).

†Specification for fixed capacitors used in electronic equipment: Part I General requirements and tests.

‡Basic climatic and mechanical durability tests for electronic components (*revised*).

TABLE 1 CLIMATIC CATEGORIES

(Clause 3.2)

SL No.	CLIMATIC TEST (see IS : 589-1961*)	SEVERITY			
		Category 1		Category 2	Category 3
		A	B		
(1)	(2)	(3)	(4)	(5)	(6)
i)	Dry heat	+125°C	+85°C	+85°C	+70°C
ii)	Cold	-55°C	-55°C	-40°C	-10°C
iii)	Damp heat (long term)	56 days	56 days	21 days	4 days
iv)	Damp heat (accelerated)	6 cycles	6 cycles	2 cycles	1 cycle
v)	Rapid change of tempera- ture	+125°C to -55°C	+85°C to -55°C	+85°C to -40°C	+70°C to -10°C
vi)	Low air pressure	2 kPa	2 kPa	8.5 kPa	60 kPa

NOTE 1 — In case of special requirements where the above categories cannot be applied strictly, the other combinations of severities may be agreed to between the manufacturer and the purchaser provided such severities are chosen from IS : 589-1961*.

NOTE 2 — Generally category 1 capacitors are of hermetically sealed type, category 2 capacitors are of moulded and dipped type and category 3 capacitors are of dipped type.

*Basic climatic and mechanical durability tests of electronic components (revised).

4. RATINGS

4.1 Rated Capacitance — The value of rated capacitance shall be chosen from E6 series of IS : 824-1965*. These values are 1.0, 1.5, 2.2, 3.3, 4.7 and 6.8 and their decimal multiples.

NOTE — Values other than the above series shall be agreed to between the purchaser and the manufacturer.

4.1.1 Tolerance on Rated Capacitance — The permissible tolerance on rated capacitance value shall be chosen from the following:

Long life grade capacitor	± 10 percent
	± 20 percent
General purpose grade capacitor	± 20 percent
	+ 50 percent
	- 20 percent

4.2 Rated Voltage — The values of dc rated voltage shall be chosen from the following:

4, 6.3, 10, 16, 20, 25, 35, 40, 63, 100 and 160 V

*Preferred values for resistors and capacitors (revised).

NOTE 1 — The values of rated voltage are derived from R5 series of IS : 1076-1967* with the addition of values 20 and 35 representing the present state of the art.

NOTE 2 — The sum of the direct voltage and the peak alternating voltage applied to the capacitor shall not exceed the rated voltage.

NOTE 3 — For short periods, however, the rated voltage may be exceeded.

NOTE 4 — The rated voltage is specified at 85°C for capacitors of category 1A and at 70°C for capacitor of other categories (see Table 2).

4.3 Category Voltage — The category voltage shall be in accordance with those specified in Table 2.

TABLE 2 RATED VOLTAGE, CATEGORY VOLTAGE AND SURGE VOLTAGE

(Clauses 4.2, 4.3, and 4.4)

CATEGORY 1A			CATEGORIES 1B & 2				CATEGORY 3	
U_R at 85°C	U_C at 125°C	U_S at 85°C	U_R at 70°C	U_C at 85°C	U_S at 70°C	U_S at 85°C	U_R at 70°C	U_S at 70°C
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
4	—	—	4	4	6	6	4	6
6.3	4	8	6.3	6.3	8	8	6.3	8
10	7	13	10	10	12	12	10	12
16	10	20	16	13	17	16	16	16
20	13	26	20	17	23	21	20	21
25	16	31	25	20	28	25	25	25
35	23	46	35	28	41	35	35	35
40	25	50	—	—	—	—	—	—
63	40	78	—	—	—	—	—	—
100	63	125	—	—	—	—	—	—

4.4 Surge Voltage — The dc surge voltage shall be as specified in Table 2.

4.5 Ripple — The permissible ripple current and/or ripple voltage shall be as specified in the relevant individual specification.

4.6 Rated Temperature — Rated temperature shall be specified as below:

For category 1A	85°C
For other categories	70°C

5. CONSTRUCTION AND WORKMANSHIP

5.1 The construction and workmanship shall be in accordance with 5 of IS : 7305 (Part I)-1973†.

*Preferred numbers (first revision).

†Specification for fixed capacitors used in electronic equipment: Part I General requirements and tests.

6. DIMENSIONS

6.1 The dimensions shall conform to those specified in relevant specification or those specified by the manufacturer.

7. MARKING

7.1 The following marking information in order of importance given below is required:

- a) Polarity:
 - 1) Positive polarity indicating the positive direction shall be marked by the symbol '+', and
 - 2) Bi-polar capacitor shall be marked positive at both ends and if space permits in addition to the letters 'BP';
- b) Rated capacitance, in microfarads;
- c) Rated voltage and category voltage (if different);
- d) Tolerance on rated capacitance (*see* IS : 8186-1976*);
- e) Category temperature (for long life grade capacitors only);
- f) Reference to the grade (for long life grade capacitors only);
- g) Manufacturer's name or trade-mark;
- h) Manufacturer's type designation; and
- j) Week (or month) and year of manufacture, this may be in coded form as in IS : 8186-1976*.

7.1.1 The capacitor shall be clearly marked with items (a), (b) and (c) of 7.1 and with as many as possible of the remaining items as are considered useful.

7.1.2 The package containing the capacitor(s) shall be clearly marked with all the information listed above as far as applicable.

7.1.3 Any additional marking shall be so applied that no confusion will arise.

7.2 The capacitors may also be marked with the ISI Certification Mark.

NOTE — The use of the ISI Certification Mark is governed by the provisions of the Indian Standards Institution (Certification Marks) Act and the Rules and Regulations made thereunder. The ISI Mark on products covered by an Indian Standard conveys the assurance that they have been produced to comply with the requirements of that standard under a well-defined system of inspection, testing and quality control which is devised and supervised by ISI and operated by the producer. ISI marked products are also continuously checked by ISI for conformity to that standard as a further safeguard. Details of conditions under which a licence for the use of the ISI Certification Mark may be granted to manufacturers or processors, may be obtained from the Indian Standards Institution.

*Marking codes for values and tolerances of resistors and capacitors.

8. TESTS

8.1 Classification of Tests

8.1.1 Type Tests

8.1.1.1 Type approval procedure — The procedure for type approval shall be in accordance with IS: 2612-1965*.

8.1.1.2 Number of samples — Unless otherwise specified, the number of samples for each type shall be 25 or 33, with 3 spares.

8.1.1.3 Selection of samples — The samples shall be representative of the range of values of the type under consideration. Samples shall comprise quantities as equal as possible of the largest and the smallest case size specimen with the lowest and the highest rated voltages. When there are more than four case sizes, an intermediate case size shall also be chosen for testing. For each case size, the samples with the highest capacitance shall be chosen. Samples of maximum capacitance at its highest voltage as well as those with maximum voltage at its highest capacitance shall be chosen.

NOTE — A capacitor subjected to type tests according to Table 3 shall not be used in equipment nor be returned to bulk supply.

8.1.1.4 Schedule of type tests — The capacitors shall be subjected to the tests specified in Table 3, in the given order. After the completion of the tests specified under group 0, the samples shall be divided into six groups for further testing.

8.1.2 Routine Tests — The following shall constitute the routine tests:

- a) Visual examination,
- b) Capacitance, and
- c) Leakage current.

8.1.3 Acceptance Tests — Two groups of samples (Groups A and B) shall be selected (see Appendix B of IS : 2612-1965*) and the capacitors in each group shall be subjected to the routine tests followed by tests specified in Table 4 in the given order.

8.2 General Condition for Tests — The general condition for tests shall be as specified in 7.2 of IS : 7305 (Part I)-1973†.

*Recommendation for type approval and sampling procedures for electronic components.

†Specification for fixed capacitors used in electronic equipment; Part I General requirements and tests.

TABLE 3 SCHEDULE OF TYPE TESTS

(*Clauses 8.1.1.3 and 8.1.1.4*)

GROUP	NUMBER OF SAMPLES				TITLE OF TEST	CLAUSE REFER- ENCE
	Each Style		Minimum Quantity			
	Maximum capaci- tance at its highest voltage	Maximum voltage at its highest capaci- tance	Maximum capaci- tance at its highest voltage	Maximum voltage at its highest capaci- tance		
(1)	(2)	(3)	(4)	(5)	(6)	(7)
0	25	25	33	33	Visual examination	8.4.1
					Dimensions	8.4.2
					Capacitance	8.3.2
					Tangent of loss angle	8.3.3
					Leakage current	8.3.1
					Voltage proof (one minute)	8.3.4
					Insulation resistance	8.3.5
					Sealing (where applicable)	8.4.10
					Solderability	8.4.4
					Robustness of termina- tions	8.4.3
1	4	4	6	6	Bump	8.4.6
					Vibration	8.4.5
					Shock	8.4.7
					Acceleration (steady state)	8.4.8
					Rapid change of temperature	8.5.3
					Climatic sequence	8.5.1
					Damp heat (steady state)	8.5.2
2	4	4	6	6	Endurance	8.7
3	8	8	12	12	Reverse voltage (for non-polar only)	8.9
4	1	1	1	1	Mould growth	8.5.5
5	3	3	3	3	Resistance to solder- ing heat	8.4.4.2
					Resistance to sol- vents	8.4.9
6	2	2	2	2	Characteristics at low and high tem- peratures	8.6
					Surge voltage	8.8
					Salt mist	8.5.4
Spares		3	3	3		

TABLE 4 SCHEDULE OF ACCEPTANCE TESTS

(Clause 8.1.3)

TEST	CLAUSe REF	AQL* (PERCENTAGE DEFECTIVE)	INSPECTION LEVEL	D/ND
(1)	(2)	(3)	(4)	(5)
Group 'A' Tests				
Dimensions	8.4.2	1 percent	II	ND
Tangent of the loss angle	8.3.3			
Sealing (where appli- cable)	8.4.10			
Group 'B' Tests				
Sub-Group I				
Electrical Endurance (168 hours)	8.7	4 percent	S3	ND
Sub-Group-II				
Robustness of termina- tions	8.4.3	4 percent	S3	D
Solderability of termina- tions	8.4.4.1			
Bump	8.4.6			
Climatic sequence	8.5.1			

ND—Non-destructive.

D—Destructive.

*IS : 2500 (Part I)-1973 Inspection by attributes and by count of defects (first revision).

8.3 Electrical Tests

8.3.1 Leakage Current — This test shall be carried out in accordance with 7.3.4 of IS : 7305 (Part I)-1973* with the following additional details/modifications:

- a) *Measuring Conditions* — The total circuit resistance shall be between 1 000 and 10 000 ohms and the leakage current shall be measured after charging the capacitor through the specified resistor for five minutes. In case of bi-polar capacitors the measurements shall first be made in one direction after an electrification period of five minutes. The polarity shall then be reversed and the measurements made again after a further electrification period not exceeding five minutes.
- b) *Requirements* — The leakage current at $27 \pm 2^{\circ}\text{C}$ shall not exceed values specified in the relevant specification.

*Specification for fixed capacitors used in electronic equipment; Part I General requirements and tests.

8.3.2 Capacitance — This test shall be carried out in accordance with 7.3.2 of IS : 7305 (Part I)-1973* with the following additional details/modifications:

- a) *Measuring Conditions* — Capacitance shall be measured at a frequency of 100 Hz. The peak alternating voltage applied across the capacitor shall be between 0.1 and 1.0 V. A dc bias voltage of valve between 2.1 and 2.5 V shall be applied during the measurement except for bi-polar capacitor which shall be measured without an applied voltage.

NOTE — If the rated voltage is equal to or greater than 6.3 V and ac measuring voltage is less than 0.5 V, no dc bias may be required.

- b) *Requirement* — The capacitance shall be within the rated tolerance.

8.3.3 Tangent of Loss Angle — This test shall be carried out in accordance with 7.3.3 of IS : 7305 (Part I)-1973* with the following additional details/modifications:

- a) *Measuring Conditions* — Measurements shall be made as specified in 8.3.2.

- b) *Requirement* — The tangent of loss angle shall not exceed the value specified in the relevant specification.

8.3.4 Voltage Proof of the Insulation (Not Applicable for Category 3) — This test shall be carried out in accordance with 7.3.1 of IS : 7305 (Part I)-1973* with the following additional details/modifications:

- a) *Measuring Conditions* — A metal foil shall be wrapped closely around the full length of the body of the capacitor, protruding by at least 5 mm from each end, provided a minimum space of 1 mm is maintained between the metal foil and the point of emergence of the terminations. The ends of the foil shall not be folded over the ends of the capacitor. When it is not possible to maintain a minimum spacing of 1 mm the protrusion of the foil shall be reduced as may be necessary to establish the 1 mm space.

When applicable, the V block method is permitted as an alternative except for the specimens where the distance between the point of emergence of terminations and the plate would be less than 1 mm.

A direct voltage, as given below, shall be applied between the metal foil and the termination connected to the body of the capacitor:

Category 1	2 000 V gradually increasing at the rate of 200 V/s with a maximum leakage current of 20 mA,
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*Specification for fixed capacitors used in electronic equipment: Part I General requirements and tests.

Categories 2 & 3 1 000 V gradually increasing at the rate of
100 V/s with a maximum leakage current
of 20 mA.

The voltage shall be applied for a period of 1 minute \pm 5 seconds.

- b) *Requirement* — There shall be no break-down or flashover during the test.

8.3.5 Insulation Resistance (Insulated Patterns Only) — The test shall be carried out in accordance with 7.3.6 of IS : 7305 (Part I)-1973* with the following additional details/modifications:

- a) *Measuring Conditions* — A metal foil shall be wrapped closely around the full length of the body of the capacitor, protruding by at least 5 mm from each end, provided a minimum space of 1 mm is maintained between the metal foil and the point of emergence of the terminations. The ends of the foil shall not be folded over the ends of the capacitors. When it is not possible to maintain the minimum spacing of 1 mm, the protrusion of the foil shall be reduced if necessary to establish the 1 mm space.

When applicable, the V-block method is permitted as an alternative except for the specimens where the distance between the point of emergence of terminations and the plate would be less than 1 mm.

A direct voltage, as given below, shall be applied between the metal foil and the termination connected to the body of the capacitor:

Category 1	500 \pm 50 V
Categories 2 and 3	100 \pm 15 V

The direct voltage shall be applied for a period of one minute or for the time required to obtain a stable reading. At the end of this period the insulation resistance shall be measured.

- b) *Requirement* — The insulation resistance shall not be less than 1000 M Ω for category 1 and 100 Ω M for categories 2 and 3.

8.4 Physical and Mechanical Tests

8.4.1 Visual Examination — The capacitor shall be visually examined for compliance with the requirements of marking and finish.

8.4.2 Dimensions — The dimensions shall be checked for compliance with those specified in the relevant specification or by the manufacturer.

*Specification for fixed capacitors used in electronic equipment; Part I General requirements and tests.

8.4.3 Robustness of Terminations

8.4.3.1 Tensile test — This test shall be carried out in accordance with **7.4.3.1** of IS : 7305 (Part I)-1973*. The load to be applied shall be 1.0 kg.

8.4.3.2 Bend test — The test shall be carried out in accordance with **7.4.3.2** of IS : 7305 (Part I)-1973* with the following additional details/modifications:

For wire terminations, two consecutive bends shall be applied in one-half of the terminations in accordance with **7.19.2.2** of IS : 589-1961†. While carrying out the bend test on wire terminations, care shall be taken to ensure that the bend occurs at a point 6 mm away from the point of emergence of wire from the capacitor. A suitable arrangement to ensure this requirement is shown in Fig. 1 of Appendix A. The lead must withstand four 90° bends.

8.4.3.3 Special bending test (for dipped types only) — Capacitors with external welds on wire bends shall be subjected only to tensile test in accordance with **8.4.3.1** and to the special bending test given in Appendix A when specifically called for in the relevant specification.

8.4.3.4 Torsion test — This test shall be carried out in accordance with **7.4.3.3** of IS : 7305 (Part I)-1973*.

The capacitors shall be subjected to two rotations of 180 degrees each.

8.4.4 Soldering

8.4.4.1 Solderability of terminations — This test shall be carried out in accordance with **7.4.4** of IS : 7305 (Part I)-1973*. The terminations shall get wet easily and the timing should be uniform and good.

NOTE — The solderability of termination may be checked by the solder globule test method (*under consideration*). The requirements for this method shall be either prescribed in the relevant specification or shall be subject to agreement between the manufacturers and the customers.

8.4.4.2 Resistance to solder heat — Unless otherwise specified, this test shall be carried out in accordance with **7.4.4** of IS : 7305 (Part I)-1973*, without any predrying.

The capacitor shall be visually examined after recovery under standard measuring condition and there shall be no visible damage or leakage of sealing material and the marking shall be legible. The capacitance shall then be measured and change of capacitance value shall be within the limits specified in the relevant specification.

*Specification for fixed capacitors used in electronic equipment: Part I General requirements and tests.

†Basic climatic and mechanical durability tests for components for electronic and electrical equipment (*revised*).

8.4.5 Vibration — This test shall be carried out in accordance with 7.4.5 of IS : 7305 (Part I)-1973* with the following additional details/modifications.

8.4.5.1 Mounting — The mounting shall be as prescribed in the relevant specifications. Supplementary mounting means should be used where the application of these capacitors involves vibration frequencies above 55 Hz.

8.4.5.2 Conditioning — The severity shall be as specified in the relevant specification chosen from the following:

<i>Frequency</i>	<i>Peak Value of Vibration Amplitude ± 10 percent</i>	<i>Duration</i>	<i>Remarks</i>
10-2 000	0.75 mm or 20 g whichever is less	12 hours	Category 1A
10-2 000	0.75 mm or 10 g whichever is less	9 hours	Categories 1B & 2
10-500	0.75 mm or 10 g whichever is less	6 hours	Category 3

8.4.5.3 Final measurements and requirements during testing — During the last half an hour of test vibration in each direction electrical measurements shall be made on the capacitors to determine intermittent faults (open or short circuits). It is desirable that the detecting equipment shall detect any interruption with a duration of 0.5 millisecond or greater. There shall be no interruption.

After the test the capacitor shall be visually examined and there shall be no mechanical damage. Marking shall be legible.

The capacitance, tangent of loss angle and leakage current shall be measured. The vibration shall be within the limit specified in the relevant specification.

8.4.6 Bump — This test shall be carried out in accordance with 7.4.7 of IS : 7305 (Part I)-1973* with the following additional details/modifications.

8.4.6.1 The method of mounting shall be as specified in the relevant specification. The degree of severity shall be:

- a) 4 000 bumps for category 1, and
- b) 1 000 bumps for categories 2 and 3.

During the bump test, capacitor shall be electrically loaded and measured as specified in relevant specification.

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8.4.6.2 Final inspection, measurement and requirement — After the test the capacitor shall be visually examined and there shall be no mechanical damage. Marking shall be legible.

The capacitance, tangent of loss angle and leakage current shall be measured. The variation shall be within the limit specified in the relevant specification.

8.4.7 Shock — This test shall be carried out in accordance with **7.4.8** of IS : 7305 (Part I)-1973*.

Method of mounting shall be as specified in the relevant specification.

Degree of severity shall be as specified in the relevant specification.

For category 1 capacitors, electrical discontinuity shall be checked throughout the test, with rated voltage applied.

After the test, the capacitors shall be visually examined. There shall be no visible damage. Any additional measurements if applicable shall be specified in the specification.

8.4.8 Acceleration — This test shall be carried out in accordance with **7.4.9** of IS : 7305 (Part I)-1973*.

Method of mounting shall be as specified in the relevant specification.

Degree of severity shall be as specified in the relevant specification.

For category 1 capacitors, electrical discontinuity shall be checked throughout the test, with rated voltage applied.

After the test, the capacitors shall be visually examined. There shall be no visible damage. Any additional measurements if applicable shall be specified in the specification.

8.4.9 Resistance to Solvent Test (Applicable for Category 1 Only) — This test shall be carried out in accordance with IS : 9000 (Part XX)-†.

8.4.10 Sealing — (Applicable for Category 1 Only) — This test shall be carried out in accordance with **7.16.1** of IS : 589-1961‡, applicable condition being as per method 2.

8.5 Climatic Tests

8.5.1 Climatic Sequence — This test shall be carried out in accordance with **7.5.1** of IS : 7305 (Part I)-1973* with the following additional details/modifications.

*Specification for fixed capacitors used in electronic equipment: Part I General requirements and tests.

†Basic environmental testing, procedures for electronic and electrical items: Part XX Resistance to cleaning solvents and permanence of markings (*under preparation*).

‡Basic climatic and mechanical durability tests for components for electronic and electrical equipment (*revised*).

8.5.1.1 Initial measurements — The capacitance shall be measured.

8.5.1.2 Dry heat — This test shall be carried out in accordance with **7.5.1.2** of IS : 7305 (Part I)-1973* with no rated voltage applied. Duration of the test shall be 16 hours unless otherwise specified in the relevant specification.

After recovery the capacitors shall be visually examined. There shall be no visible damage and shall show no seepage of sealing material. Marking shall be legible.

8.5.1.3 Damp heat (accelerated) first cycle — This test shall be carried out in accordance with **7.5.1.3** of IS : 7305 (Part I)-1973* with no rated voltage applied.

After recovery the capacitors shall be visually examined. There shall be no visible damage and shall show no seepage of sealing material. Marking shall be legible.

8.5.1.4 Cold — This test shall be carried out in accordance with **7.5.1.4** of IS : 7305 (Part I)-1973* with no rated voltage applied. The duration of exposure shall be 2 hours unless otherwise specified in the relevant specification.

During the last 10 minutes of the period of exposure the rated voltage shall be applied to the specimens.

After recovery the capacitors shall be visually examined. There shall be no visible damage and shall show no seepage of sealing material. Marking shall be legible.

The capacitor shall remain under recovery condition for 2 to 4 hours. They shall then be removed from the recovery chamber and shaken by hand to remove droplets of water.

8.5.1.5 Low air pressure — This test shall be carried out in accordance with **7.5.1.5** of IS : 7305 (Part I)-1973* with the following additional details/modifications.

No initial measurements are required. Conditioning of capacitors shall consist of subjecting to an air pressure of 20 mbar for a period of 5 minutes the ambient temperature being between 15°C and 35°C. During the last minute of the conditioning the rated direct voltage shall be applied. During and after tests there shall be no evidence of breakdown or flashover and no harmful deformation of the case.

8.5.1.6 Damp heat (accelerated) remaining cycles — This test shall be carried out in accordance with **7.5.1.6** of IS : 7305 (Part I)-1973* with the following additional details/modifications.

*Specification for fixed capacitors used in electronic equipment: Part I General requirements and tests.

After recovery the capacitor shall be visually examined. There shall be no visible damage. The marking shall be legible.

NOTE — The remaining damp heat cycles required are as follows:

Category 1	5 cycles
Category 2	1 cycle
Category 3	0 cycle

8.5.1.7 Final inspection, measurements and requirements — The capacitor shall be subjected to tangent of loss angle, leakage current, capacitance, insulation resistance and voltage proof tests. The variations shall be within the limits specified in the relevant specification.

8.5.2 Damp Heat (Steady State) — This test shall be carried out in accordance with 7.5.2 of IS : 7305 (Part I)-1973* with the following additional details/modifications:

For category 1 half the samples shall be loaded with rated voltage during the test. For categories 2 and 3 no voltage shall be applied.

After recovery the capacitor shall be visually examined. There shall be no seepage of sealing material and visual damage. The marking shall be legible.

The capacitor shall then be subjected to leakage current, capacitance, insulation resistance and voltage proof tests. The variation shall be within the limits specified in the relevant specification.

8.5.3 Rapid Change of Temperature — This test shall be carried out in accordance with 7.5.3 of IS : 7305 (Part I)-1973*.

After recovery the capacitor shall be visually examined. There shall be no seepage of sealing material and visual damage. The marking shall be legible. For category 1 capacitors, $\tan \delta$ and leakage current shall be measured.

The capacitance shall then be measured. The change of capacitance value shall be within the limits specified in the relevant specification.

8.5.4 Salt Mist — This test shall be carried out in accordance with 7.5.5 of IS : 7305 (Part I)-1973*. The duration of the exposure shall be 4 days. The requirements shall be as stated in IS : 7305 (Part I)-1973*.

8.5.5 Mould Growth — This test shall be carried out in accordance with 7.5.4 of IS : 7305 (Part I)-1973*.

8.6 Characteristics at High and Low Temperature (for Categories 1 and 2 Only) — The following measurements shall be made at each step of indicated temperature. The measurements shall be carried out at thermal

*Specification for fixed capacitors used in electronic equipment: Part I General requirements and tests.

stability which has been reached when no appreciable variation of capacitance has occurred during the preceding 15 minutes.

<i>Temperature</i>	<i>Measurement</i>
27°C	Leakage current, capacitance and tangent of loss angle
Low temperature	Capacitance and tangent of loss angle
High temperature	Leakage current, capacitance and tangent of loss angle

Capacitors shall meet the requirements as specified in the relevant specification.

The capacitors shall be subjected successively to dry heat and cold test at the appropriate degrees of severity (see 8.5.1.2 and 8.5.1.4).

8.7 Endurance — This test shall be carried out in accordance with 7.9 of IS : 7305 (Part I)-1973* with the following additional details/modifications.

8.7.1 Conditioning — The capacitor shall be tested at the temperature and with test voltage applied as specified below:

<i>Category</i>	<i>Test Temperature</i>	<i>Test Voltages</i>
1A	50 percent of the samples at 85°C	Rated voltage
	50 percent of the samples at 125°C	Category voltage
1B & 2	50 percent of the samples at 70°C	Rated voltage
	50 percent of the samples at 85°C	Category voltage
3	All samples at maximum category temperature	Rated voltage

During the test of bi-polar capacitors, the applied voltage shall be reversed polarity at intervals of 168 ± 24 hours.

The test voltage shall be applied gradually (not less than 2 minutes but not more than 5 minutes) by a slow build up of voltage through a resistor, 10 k Ω which shall be shorted out within 5 minutes. The impedance of the voltage source shall not exceed 3 ohms.

*Specification for fixed capacitors used in electronic equipment: Part I General requirements and tests.

The duration of the test shall be 2 000 hours for category 1 capacitors and 1 000 hours for categories 2 and 3 capacitors.

Leakage current shall be measured after 500 hours.

8.7.1.1 Recovery — The capacitor shall be subjected to recovery condition for a period of 16 hours under standard atmospheric condition for testing.

8.7.1.2 Final inspection, measurements and requirements — The capacitors shall be visually examined and there shall be no visible damage or leakage of sealing material. Marking shall be legible.

The capacitance, tangent of loss angle and leakage current shall be measured. The variation shall be within the limits specified in the relevant specification.

8.8 Surge — This test shall be carried out in accordance with 7.8 of IS : 7305 (Part I)-1973* with the following additional details/modifications.

8.8.1 The capacitors shall be subjected to 1 000 cycles. Each cycle shall consists of 30 seconds of surge voltage followed by $5\frac{1}{2}$ minutes discharge period. Voltage application shall be made through a resistor of $1\ 000 \pm 100$ ohms.

Each surge voltage cycle shall be performed in such a manner that the capacitor is discharged through the resistor of approximately 1 000 ohms at the end of the 30 seconds application.

The test shall be terminated on the discharge portion of the cycle. For bi-polar capacitors the polarity shall be reversed after 500 cycles.

The test shall be conducted at the following temperature:

Maximum Category Temperature

$\leq 85^{\circ}\text{C}$

$> 85^{\circ}\text{C}$

Test Temperature

All samples at maximum category temperature

50 percent of the samples at 85°C and the remaining

50 percent at the maximum category temperature

The test voltage shall be as specified in Table 2.

8.8.1.1 Recovery — The capacitor shall be subjected to recovery condition under standard atmospheric condition for testing.

8.8.1.2 Final inspection, measurements and requirements — The capacitance, tangent of loss angle and leakage current shall be measured. The variation shall be within the limits specified in the relevant specification.

8.9 Reverse voltage (for Non-polar Only) — Under consideration.

*Specification for fixed capacitors used in electronic equipment: Part I General requirements and tests.

APPENDIX A
(*Clauses 8.4.3.2 and 8.4.3.3*)

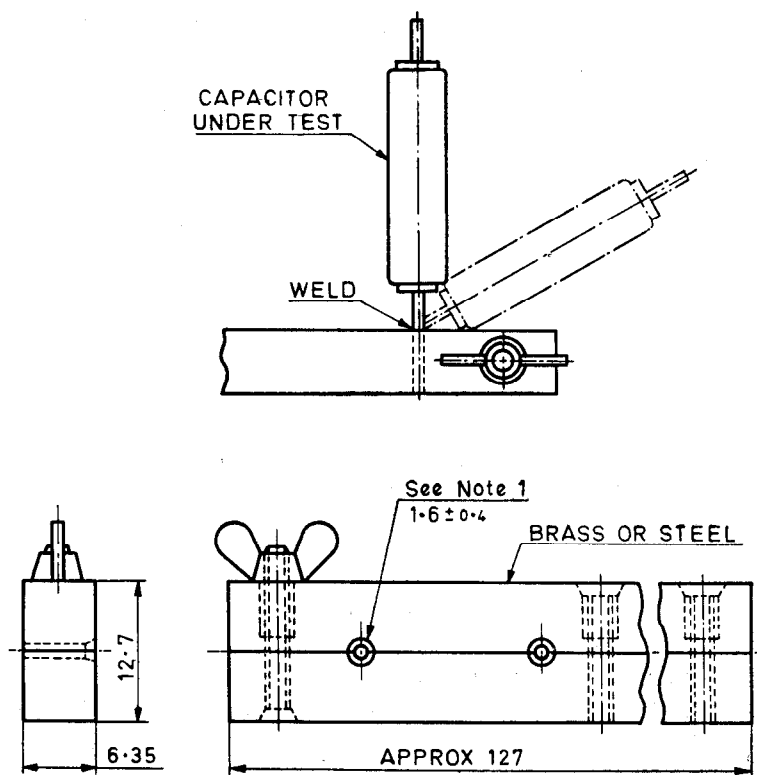
SPECIAL BENDING TEST

A-1. OBJECT

A-1.1 The object of this test is to determine the ability of the termination to withstand the bending likely to be applied during normal assembly operation.

A-2. APPARATUS

A-2.1 The apparatus for special bending test is given in Fig. 1.



NOTE — The diameter of the countersunk hole shall be 0.025 mm less than the diameter of the lead wire.

All dimensions in millimetres.

FIG. 1 APPARATUS FOR SPECIAL BENDING TEST

A-3. PROCEDURE

A-3.1 The lead shall be inserted into the hole of the fixture (Fig. 1) so that the lower side of the weld on the soldered joint is approximately flush with the surface of the fixture. The case shall be forced over in such a manner that the tantalum stub is maintained in its axial position as closely as possible while bending the lead until the end of the case touches the top surface of the fixture.

A-3.1.1 When the case is returned to its normal position, one bend will have been completed.

A-3.1.2 Succeeding bends shall be made in the alternate directions.

A-3.1.3 The lead shall meet four bends.

INDIAN STANDARDS

ON

CAPACITORS

IS :

- 590-1964 Fixed paper dielectric capacitors for dc (*revised*)
- 824-1965 Preferred values for resistors and capacitors (*revised*)
- 1885 (Part XLV)-1977 Electrotechnical vocabulary: Part XLV Capacitors
- 1980-1967 Ceramic dielectric capacitors, Type 1 (*first revision*)
- 2001-1968 Fixed silvered mica capacitors (*first revision*)
- 2612-1965 Recommendation for type approval and sampling procedures for electronic components
- 2786-1965 Ceramic dielectric capacitors, Type II
- 3671 (Part I)-1966 Air dielectric variable capacitors: Part I Tests and general requirements
- 3723-1966 Capacitors for radio interference suppression
- 4317 (Part I)-1967 Aluminium electrolytic capacitors: Part I General requirements and tests
- 4633-1968 Fixed metallized-paper dielectric capacitors for direct current
- 5361-1969 Polyester film dielectric capacitors for direct current
- 5475-1969 Polystyrene film dielectric capacitors
- 7305 (Part I)-1973 Fixed capacitors used in electronic equipment: Part I General requirements and tests
- 7305 (Part II)-1976 Fixed capacitors used in electronic equipment: Part II Ceramic dielectric capacitors, Type I
- 7548 (Part I)-1977 Variable capacitors: Part I Tests and general requirements
- 8083-1976 Dimensions of ceramic dielectric capacitors of the plate type
- 8238-1976 Guide for use of variable capacitors in electronic equipment
- 8186-1976 Marking codes for value and tolerances of resistors and capacitors (*super-seding* IS : 825-1956 and IS : 4114-1967)
- 8507 (Part I)-1977 Specification for fixed tantalum capacitors with solid electrolyte: Part I General requirements and methods of tests